Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-44 (cancelled).

45. An apparatus for transmitting an optical signal comprising:

an optical signal source configured to generate an optical signal;

a data modulator coupled to said optical signal source and configured to modulate data on said optical signal at a data modulation frequency;

an amplitude modulator coupled to said optical signal source and configured to modulate the intensity of said optical signal at an amplitude modulation frequency phase locked to said data modulation frequency.

46. The apparatus of claim 45 wherein said amplitude modulation frequency is equal to said data modulation frequency.

47. The apparatus of claim 45, wherein said data modulation frequency is provided by a clock coupled to said amplitude modulator.

48. The apparatus of claim 47, wherein said clock is further coupled to said data modulator.

49. The apparatus of claim 45 wherein the optical signal source includes a continuous-wave optical signal generator, wherein said data is provided to said data modulator by a data source coupled to said data modulator, and wherein said apparatus further comprises a clock for establishing the data modulation frequency.

50. The apparatus of claim 49, wherein said continuous-wave optical signal generator comprises a laser.

51. The apparatus of claim 45 wherein the amplitude modulator modulates the amplitude of said optical signal at said data modulation frequency with a prescribed phase.

52. The apparatus of claim 51 further comprising a clock for establishing said data modulation frequency and an electrical variable-delay line coupling said clock to said amplitude modulator for selectively varying the prescribed phase.

53. The apparatus of claim 52 wherein said electrical variable-delay line is a phase shifter.

54. The apparatus of claim 51 wherein said amplitude modulator includes means for selectively adjusting the degree of intensity modulation that is imparted to said optical signal.

55. The apparatus of claim 45 wherein said amplitude modulator includes means for selectively adjusting the degree of intensity modulation that is imparted to said optical signal.

56. The apparatus of claim 45 further comprising a polarization modulator coupled to said data modulator for modulating the state of polarization of said optical signal at said data modulation frequency such that an average value of the state of polarization over a modulation cycle is substantially equal to zero.

57. The apparatus of claim 56 further comprising a clock for establishing said data modulation frequency, said clock being coupled to said polarization modulator.

58. The apparatus of claim 56 wherein said polarization modulator is coupled to said data modulator through said amplitude modulator.

59. The apparatus of claim 56 wherein said polarization modulator modulates the state of polarization by tracing the polarization of said optical signal along at least a portion of a Poincare sphere.

60. The apparatus of claim 56 wherein the polarization modulator modulates the state of polarization of the optical signal at said data modulation frequency with a prescribed phase.

61. The apparatus of claim 60, further comprising an electrical variable-delay line coupled to said polarization modulator for selectively varying the prescribed phase.

62. The apparatus of claim 61 further comprising a clock for establishing said data modulation frequency, wherein said electrical variable-delay line couples said clock to said polarization modulator.

63. The apparatus of claim 61 wherein said electrical variable-delay line is a phase shifter.

64. The apparatus in accordance with claim 45 further comprising a phase modulator coupled to said data modulator, said phase modulator configured to provide optical phase modulation to said optical signal.

65. The apparatus of claim 64 wherein said amplitude modulator is coupled to said data modulator through said phase modulator.

66. The apparatus of claim 65 further comprising a clock for establishing said data modulation frequency, and wherein said clock is coupled to said phase modulator so that said phase modulator provides optical phase modulation at a frequency that is phase locked and equal to said data modulation frequency.

67. The apparatus of claim 66 further comprising an electrical variable-delay line coupling said clock to said phase modulator for selectively varying the phase of said optical phase modulation provided by the phase modulator.

68. The apparatus of claim 67 wherein said electrical variable-delay line is a phase shifter.

69. The apparatus of claim 64 further comprising a clock for establishing said data modulation frequency, and wherein said clock is coupled to said phase modulator, such that said phase modulator provides phase modulation at a frequency that is phase locked and equal to said data modulation frequency.

70. The apparatus in accordance with claim 64 wherein said phase modulator is coupled to said data modulator through said amplitude modulator.

71. The apparatus of claim 70 further comprising a clock for establishing said data modulation frequency, wherein said clock is coupled to said phase modulator, such that said phase modulator provided phase modulation at a frequency that is phase locked and equal to said data modulation frequency.

72. The apparatus of claim 45 wherein said amplitude modulator is driven by a sinusoidal signal to modulate said intensity of said optical signal.

73. An apparatus for transmitting an optical signal comprising:

a data modulator configured to modulate data onto an optical signal at a data modulation frequency;

an amplitude modulator configured to modulate said optical signal; and

a clock having a frequency that determines the frequency of a modulation cycle of said amplitude modulator, said frequency of the clock being phased locked to said data modulation frequency.

74. The apparatus of claim 73 wherein said frequency of the clock is equal to said data modulation frequency.

75. The apparatus of claim 73 wherein said clock is coupled to the amplitude modulator.

76. The apparatus of claim 73, wherein the amplitude modulator modulates the amplitude of the optical signal at said data modulation frequency with a prescribed phase.

77. The apparatus of claim 76 further comprising an electrical variable-delay line coupling said clock to said amplitude modulator for selectively varying the prescribed phase.

78. The apparatus of claim 77, wherein said electrical variable-delay line is a phase shifter.

79. The apparatus of claim 76 wherein said amplitude modulator includes means for selectively adjusting the degree of intensity modulation that is imparted to said optical signal.

80. The apparatus of claim 73 wherein said amplitude modulator includes means for selectively adjusting the degree of intensity modulation that is imparted to said optical signal.

81. The apparatus of claim 73, further comprising a polarization modulator coupled to said data modulator for modulating the state of polarization of said optical signal at said data modulation frequency such that an average value of the state of polarization over a modulation cycle is substantially equal to zero.

82. The apparatus of claim 81 wherein said clock is coupled to said polarization modulator.

83. The apparatus of claim 81 wherein said polarization modulator is coupled to said data modulator through said amplitude modulator.

84. The apparatus of claim 81 wherein said polarization modulator modulates the state of polarization by tracing the polarization of said optical signal along at least a portion of a Poincare sphere.

85. The apparatus of claim 81 wherein the polarization modulator modulates the state of polarization of the optical signal at said data modulation frequency with a prescribed phase.

86. The apparatus of claim 85 further comprising an electrical variable-delay line coupled to said polarization modulator for selectively varying the prescribed phase.

87. The apparatus of claim 86 wherein said electrical variable-delay line couples said clock to said polarization modulator.

88. The apparatus of claim 86 wherein said electrical variable-delay line is a phase shifter.

89. The apparatus of claim 73 further comprising an optical phase modulator coupled to said data modulator, said phase modulator providing optical phase modulation to said optical signal.

90. The apparatus of claim 89 wherein said amplitude modulator is coupled to said data modulator through said phase modulator.

91. The apparatus of claim 89 wherein said clock is coupled to said optical phase modulator so that said optical phase modulator provides optical phase modulation at a frequency that is phase locked and equal to said data modulation frequency.

92. The apparatus of claim 91 further comprising an electrical variable-delay line coupling said clock to said optical phase modulator for selectively varying the phase of said optical phase modulation provided by the optical phase modulator.

93. The apparatus of claim 92 wherein said electrical variable-delay line is a phase shifter.

94. The apparatus of claim 73 wherein said amplitude modulator is driven by a sinusoidal signal to modulate said intensity of said optical signal.

95. A method for transmitting an optical signal comprising:

generating an optical signal;

modulating data on said optical signal at a data modulation frequency; and

modulating the amplitude of said optical signal at an amplitude modulation frequency phase locked to said data modulation frequency.

96. The apparatus of claim 95 wherein said amplitude modulation frequency is equal to said data modulation frequency.

97. The method claim 95 further comprising selectively adjusting the degree of the amplitude modulation imparted to said data modulated signal.

98. The method of claim 95 wherein said modulating data on said optical signal is performed before said modulating the amplitude of said optical signal.

99. The method of claim 95 further comprising the step of selectively varying the phase of the amplitude modulation imparted to said optical signal.

100. The method of claim 95 further comprising the step of selectively phase modulating said optical signal while imparting substantially no polarization modulation to the optical signal.

101. The method of claim 100 wherein the step of selectively phase modulating said optical signal comprises the step of selectively phase modulating said optical signal at a frequency equal to said data modulation frequency.

102. The method of claim 95 wherein the step of modulating the amplitude of said optical signal comprises driving an amplitude modulator with a sinusoidal signal.

103. A transmission system comprising:

a transmitter including:

an optical signal source for generating an optical signal;

a data modulator coupled to said optical signal source for modulating data at a data modulation frequency;

an amplitude modulator coupled to the optical signal source for modulating the intensity of said optical signal;

a clock coupled to the amplitude modulator having a frequency that determines the frequency of the amplitude modulator, said frequency of the clock being phase locked to said data modulation frequency;

an optical transmission path coupled to said transmitter; and

a receiver coupled to the optical transmission path.

104. The apparatus of claim 103 wherein said frequency of the clock is equal to said data modulation frequency.

105. The system of claim 103 further comprising:

means for measuring a predetermined characteristic of an optical signal received by the receiver;

means for transmitting the predetermined characteristic to the transmitter; and

means for selectively varying the amplitude modulation imparted to said optical signal to optimize the value of the predetermined characteristic.

106. The system of claim 105 wherein said means for selectively varying the amplitude modulation comprises means for selectively varying the phase of said amplitude modulation.

107. The system of claim 105 wherein said means for selectively varying the amplitude modulation comprises means for selectively varying the amount of said amplitude modulation.

108. The system of claim 103, further comprising a polarization modulator coupled to said data modulator for modulating the state of polarization of said optical signal at said data modulation frequency such that an average value of the state of polarization over a modulation cycle is substantially equal to zero.

109. The system of claim 108 wherein said clock is coupled to said polarization modulator.

110. The system of claim 108 wherein said polarization modulator is coupled to said data modulator through said amplitude modulator.

111. The system of claim 108 wherein said polarization modulator modulates the state of polarization by tracing the polarization of said optical signal along at least a portion of a Poincare sphere.

112. The system of claim 108 wherein the polarization modulator modulates the state of polarization of the optical signal at said data modulation frequency with a prescribed phase.

113. The system of claim 112 further comprising an electrical variable-delay line coupled to said polarization modulator for selectively varying the prescribed phase.

114. The system of claim 113 wherein said electrical variable-delay line couples said clock to said polarization modulator.

115. The system claim 113 wherein said electrical variable-delay line is a phase shifter.

116. The system of claim 108 further comprising:
means for measuring a predetermined characteristic of an optical signal received by the receiver;
means for transmitting the predetermined characteristic to the transmitter; and
means for selectively varying the polarization modulation imparted to said optical signal to optimize the value of the predetermined characteristic.

117. The system of claim 116 wherein said predetermined characteristic comprises the signal-to-noise ratio of the optical signal received by the receiver.

118. The system of claim 116 wherein said predetermined characteristic comprises the Q-factor of the optical signal received by the receiver.

119. The system of claim 103 further comprising a phase modulator coupled to said data modulator, said phase modulator configured to provide optical phase modulation to said optical signal.

120. The system of claim 119 wherein said amplitude modulator is coupled to said data modulator through said phase modulator.

121. The system of claim 119 wherein said optical phase modulator provides optical phase modulation to said optical signal while imparting substantially no polarization modulation thereto.

122. The system of claim 119 further comprising:
means for measuring a predetermined characteristic of an optical signal received by the receiver;
means for transmitting the predetermined characteristic to the transmitter; and
means for selectively varying the phase modulation imparted to said optical signal to optimize the value of the predetermined characteristic.

123. The system of claim 122 wherein said predetermined characteristic comprises the signal-to-noise ratio of the optical signal received by the receiver.

124. The system of claim 122 wherein said predetermined characteristic comprises the Q-factor of the optical signal received by the receiver.

125. The system of claim 119 wherein said clock is coupled to said optical phase modulator so that said optical phase modulator provides optical phase modulation at a frequency that is phase locked and equal to said data modulation frequency.

126. The system of claim 125 further comprising an electrical variable-delay line coupling said clock to said optical phase modulator for selectively varying the phase of said optical phase modulation provided by the optical phase modulator.

127. The system of claim 126 wherein said electrical variable-delay line is a phase shifter.

128. The system of claim 105 wherein said predetermined characteristic comprises the signal-to-noise ratio of the optical signal received by the receiver.

129. The system of claim 105 wherein said predetermined characteristic comprises the Q-factor of the optical signal received by the receiver.

130. The system of claim 103 wherein said amplitude modulator is driven by a sinusoidal signal to modulate said intensity of said optical signal.

131. An optical communication system comprising:

an optical signal source for providing an optical signal;

data modulation means for modulating data onto said optical signal at a data modulation frequency; and

amplitude modulation means for modulating an amplitude of said optical signal at a frequency phase locked to said data modulation frequency.

132. The system of claim 131, wherein said frequency is equal to said data modulation frequency.

133. The system of claim 131, wherein said amplitude modulation means is configured to modulate said amplitude of said optical signal prior to modulation of data onto said optical signal by said data modulation means.

134. The system of claim 131, wherein said amplitude modulation means is configured to modulate said amplitude of said optical signal with modulation of data onto said optical signal by said data modulation means.

135. The system of claim 131, wherein said amplitude modulation means comprises a data source coupled to said data modulator.

136. The system of claim 135, wherein said data source is configured to provide an electrical waveform to said data modulator for modulating said amplitude of said optical signal.

137. The system of claim 131, wherein said amplitude modulation means is coupled to said optical signal source.

138. The system of claim 137, wherein said amplitude modulation means is configured to provide an electrical waveform to said optical signal source for modulating said amplitude of said optical signal.

139. The system of claim 137, wherein said optical signal source comprises a laser.

140. A method of generating a data carrying optical signal in a communication system, said method comprising:

providing an optical signal; and

modulating a plurality of digital ones and zeros onto said optical signal with a value of said optical signal between consecutive occurrences of said digital ones being less than a value representing a digital one and greater than a value representing a digital zero.

141. The method of claim 140, wherein said consecutive occurrences of said digital ones are modulated in a predetermined bit period, and wherein the value of said optical signal representing said consecutive digital ones has a maximum associated with each of said consecutive digital ones in consecutive bit periods and exhibits a sinusoidal variation between said maxima.